Grinding & Superfinishing Methods & Specifications

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- **Development of High Strength Steel & Chrome Plating Grinding Specification**
- **Draft AMEC – 08AA → Published as AMS 2453**
- **Low Stress Grinding of High Strength Steel Parts Heat Treated to 180 KSI or Over, and Low Stress Grinding of Chrome Plating Applied to High Strength Steel Parts Heat Treated to 180 KSI or Over**
- **This Grinding Specification provides an option or an alternative to MIL-STD-866 which is no longer active for new design**

Low Stress Grinding Specification for Steel & Chrome Plating Published in August 2010 as AMS 2453

Grinding of HVOF Sprayed Tungsten Carbide Coatings Applied to High Strength Steels

Published in July 2004

as AMS 2449

- **Development of HVOF Superfinishing Specification**
- **The NASA Technical Standards Program (NTSP) is sponsored by the Office of the Chief Engineer (OCE).**
- **The primary mission is the enhancement of NASA's engineering capabilities by providing technical standards required to meet the needs of the Agency.**
- **The NTSP provides these standards to the Agency by doing the following:**
  - supporting the development of non-Government Voluntary Consensus Standard (VCS) Industry Standards

- **Technical Standards Budget supporting the development of non-Government VCS Industry Standards**

– FY-10	SLIM
– FY-11	NONE
– FY-12	NONE

- **SERDP provided support to attend SAE Technical Committee Meetings for completion of the Superfinishing Document and Publication as an Aerospace Material Specification.**

- **Superfinishing of HVOF Applied Tungsten Carbide Thermal Spray Coatings**
- **AMS Specification covers two methods:**
  - **Oscillating Stone Method**
  - **Tape or Abrasive Film Method**

- **Oscillating Stone Method**
  - Type and grit sizes of abrasives to be used
  - Cutting fluids/coolants
  - Workpiece surface speeds
  - Contact pressure for stones
  - Traverse rates
  - Stone oscillation rates
  - Polishing with diamond paste

- **Tape or Abrasive Film Method**
  - Microfinishing Film
  - Lapping Film
  - Type and grit sizes of abrasives to be used
  - Cutting Fluids/Coolants
  - Workpiece surface speeds
  - Film index rates
  - Contact pressure for film superfinishing
  - Traverse rates
  - Film oscillation frequency

Title Changed To: Superfinishing of HVOF Applied Tungsten Carbide Coatings

Title changed to be less restrictive -
"applied to High Strength Steels" deleted from title to allow for superfinishing of coatings applied to Titanium

Reference source handbook and website link added to Section 8 for additional information on surface finish parameters, terms, & sketches

Superfinishing of HVOF Applied Tungsten Carbide Coatings

Published in June 2011

as AMS 2452

Surface Finish Requirements After Superfinishing

- April 24-25, 2006 SAE A-5 Landing Gear Meeting in Sacramento, CA
- To discuss inconsistensies in surface finish parameters used to characterize a surface finish
- Need for more standardized parameters and terminology to characterize the required surface finish depending on the application

- **ARP 5935 (published 2007) Use of HVOF Thermal Spray Coatings for Hard Chrome Replacement in Landing Gear Applications**
  - Type 1 are surfaces that require seals/hydraulic fluid/sliding member
  - Examples include Landing Gear Strut and Actuator Piston Barrels
  - To maximize seal life, Superfinishing is required
  - Recommended surface finish parameters include:
  - Ra 4 µinch or better (roughness average)
  - Rz 40 µinch max (avg. peak-to-valley)
  - Rp 8 µinch max (mean line to highest peak)
  - R_{mr} 70 to 90% @ C_o = 5% and $C_1 = 0.25R_z$

Surface Finishing Requirements

- Need for more standardized parameters to characterize the required surface finish depending on the application
- Joe O'Hearn, Process Engineer at Supfina working with ASME B46.1 committee on standardization of parameters
- Supfina working with ASME B46.1 for about 2 years
- Presentation at their meeting in September 2010 on specifications containing multiple surface roughness parameters, including AMS 2452
- ASME focus more on instrumentation and definitions of parameters and not on how they are used in a specific industry
  (i.e. ASME focus not on specific "applications")

NOTICE (at very beginning of AMS 2452)

ORDERING INFORMATION: The following information shall be provided to the superfinishing processor by the purchaser.

1) Purchase order shall specify not less than the following:
   - Coating acceptance criteria if not as specified herein
   - Minimum and Maximum surface finish requirements
   - Examples: Ra (roughness average)
   - Rz (avg. peak-to-valley height)
   - Rp (mean line to highest peak)
   - Rmr (bearing ratio) also referred to as Tp, Mr, Rtp
   - Or other relevant parameters may be specified as necessary to adequately characterize the required surface finish depending on the application.


Questions ? ? ?

Backup Slides

- **Use of HVOF Thermal Spray Coatings for Hard Chrome Replacement in Other Applications**
- **Hydraulic Actuator Piston Rods**
  - Applications with seals/hydraulic fluid/sliding member
  - Hydraulic Actuator Piston Rods
  - To maximize seal life, Superfinishing is required
  - Recommended surface finish parameters may include:
  - Ra 4 µinch or better
  - Rz 40 µinch max (avg. peak-to-valley)
  - Rp 8 µinch max (mean line to highest peak)
  - R_{mr} 70 to 95% @ C_o = 5% and $C_1 = 0.25R_z$

- Bearing Ratio or Material Ratio
- R_{mr} 70 to 90% @ C_o = 5% and $C_1 = 0.25R_z$
- The ratio of material to air in a horizontal slice through the surface profile expressed as a percentage.
- The zero percent or reference line for the bearing ratio is located at the top of the highest peak within the evaluated profile.
- The bearing ratio may be measured at different depths (e.g. C_1, C_2, C_3) through the profile and varies with slice depth.
- To avoid dependence of the bearing (or material) ratio on a single peak, a reference line is selected to shift the reference line below the highest profile peak.
- The reference line is specified as a bearing (material) ratio percentage.

- Specifying a five percent reference line indicates that the top five percent of the profile is not included in the bearing ratio calculation.
- A reference line of C_{ref} = 5% (also referred to as C_o= 5%) is commonly used for applications covered by this specification.
- A slice depth of C_1= 0.25Rz is commonly used as the slice depth at which to measure bearing ratio for applications covered by this specification.
- Other slice depths commonly used include 6, 8, & 10 µinch